

3.3 MEASUREMENTS OF NITRIC OXIDE IN THE STRATOSPHERE AT 44°N IN AUTUMN

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Precision of the chemiluminescent instrument for balloon-borne NO measurement has been improved by precise determinations of the flow rates of the sample air and the calibration NO in N₂ gas. Based on the new calibration of these values, NO mixing ratio in the stratosphere has been reanalyzed. The revision of the NO data does not at all alter the form of the diurnal variation. The average of the four NO profiles between 15 and 32 km obtained at 44°N in autumn is given.

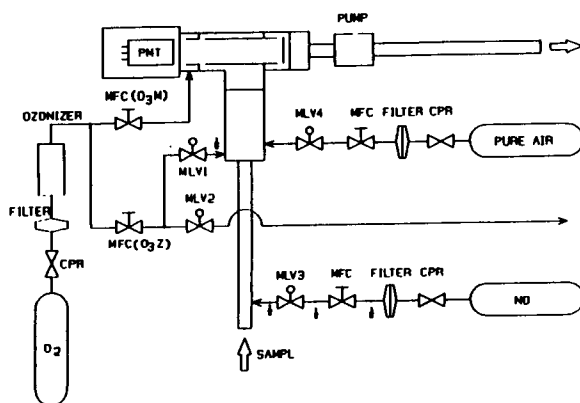


Figure 1. We have made some modifications to the NO chemiluminescent instrument described by Kondo et al. [1985]. Both the ozone/oxygen flow injected into the reaction chamber and the flow used for zeroing are regulated by mass flow controllers. The ozone/oxygen flow used for zeroing is exhausted directly outside the instrument. This reduces the mass flow rate during the measurement mode and thus reduces an uncertainty in estimating the net sample flow rate especially at high altitude. To measure the zero level of the instrument, purified air with an NO concentration of less than 5 pptv is injected into the system for 40 s every 10 minutes.

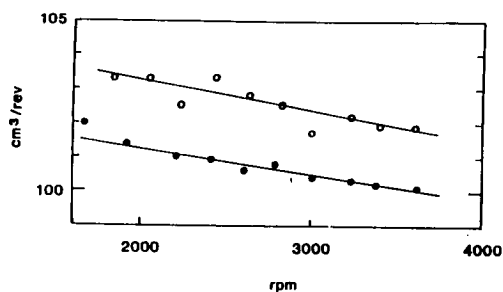


Figure 2. Calibration of the pumping rate at 1 atmosphere with no flow resistance. It can be seen that the pumping volume per 1 revolution of the rotor is almost constant of 100 cm^3 independent of the rotor frequency.

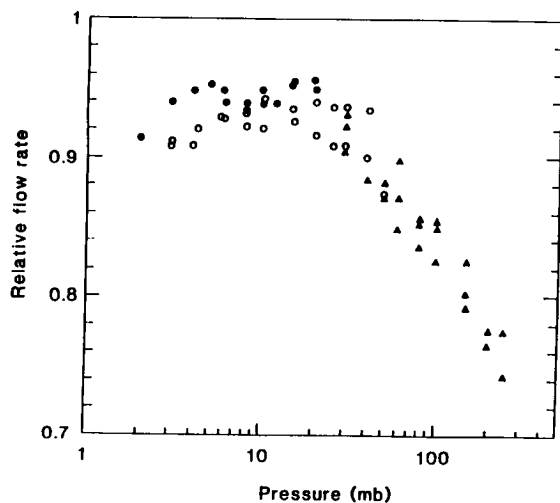


Figure 3. Change of the pumping rate with the pressure when the pump is connected to the reaction chamber and other parts of the instrument. The value given is relative to that measured when the pump is not connected to the reaction chamber.

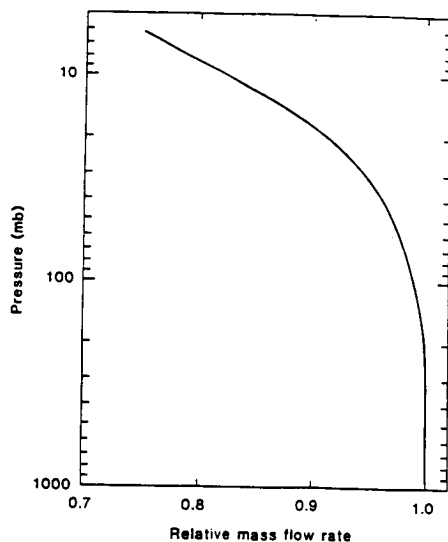


Figure 4. To regulate the flow of the calibration NO in N_2 , a mass flow controller is used. The sensitivity of the mass flow sensor increases with ambient pressure and thus results to a corresponding decrease of the net mass flow of the NO/N_2 gas. The change of the mass flow rate with the ambient pressure has been calibrated.

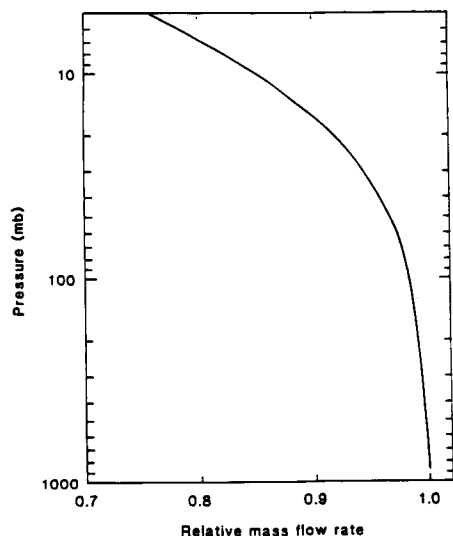


Figure 5. Same as Figure 4 but for ozone/oxygen flow. The effect of the change of this flow is not so significant in deriving the NO concentration.

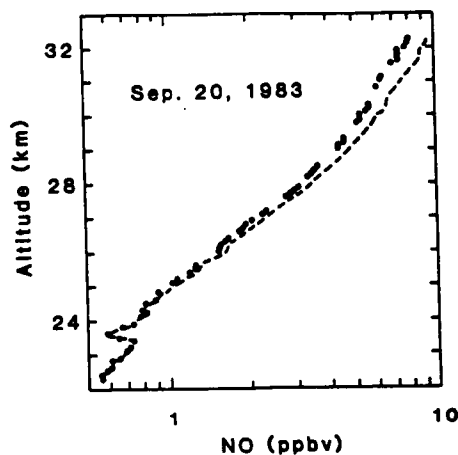


Figure 6. The NO mixing ratio has been calculated by taking into account the new calibration data of the pumping rate and the change in the sensitivity of the mass flow controllers with altitude. The dashed curve is the previous value given in Kondo et al. [1985] measured during the MAP/GLOBUS 1983 campaign. Closed circles are the new values revised this time.

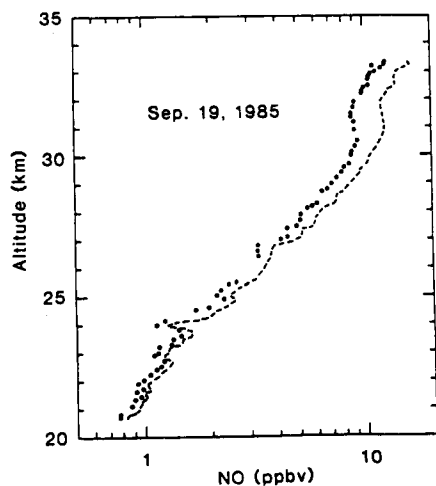


Figure 7. The same as Figure 6 but for the data on September 19, 1985.

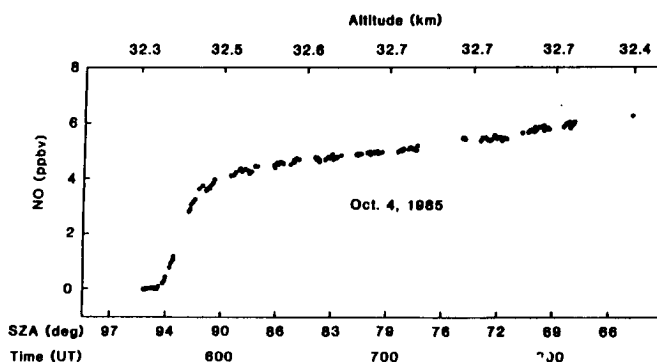


Figure 8. Temporal variation of NO measured near sunrise on October 4. NO concentration is about 77% of that given in Kondo et al. [1988]. The form of the diurnal variation relative to its daytime value is not changed at all. The N_2O_5 concentration derived from the analysis of the NO increase is also reduced to 3.0 ± 1.2 ppbv. This value is very close to the value derived by Evans [1986] from infrared emission measurements during the nighttime.

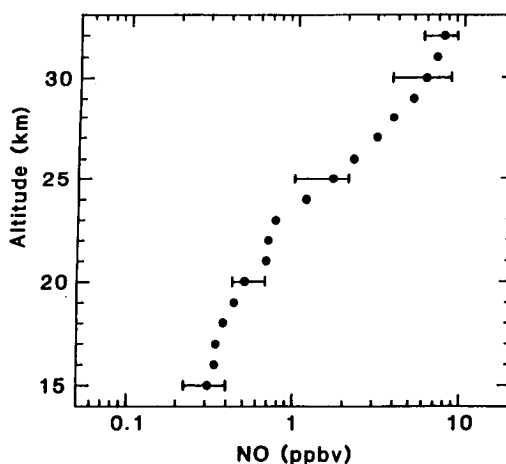


Figure 9. Thus far measurements of NO have been made four times from Aire-sur-l'Adour, France (44°N). Namely, on September 20, 1983; September 19, 1985; October 4, 1985; and September 17, 1987. NO was measured between 0830 and 1330 UT. The average of the four profiles is shown. The profile can be a reference of NO at midlatitude in autumn.